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ABSTRACT

This report reviews research which characterizes the motor skill capacity of older persons, 50 years of age and beyond. Research dealing with sensory-motor systems, memory, and practice factors receives major attention. Suggestions for future research include the following: (a) social psychological parameters which contribute to motor learning and performance difficulties; (b) changes with age of vision, taste, smell, pain, and touch, and whether they are peripheral or central; (c) the notion of "slowing" as a theory; and (d) receptor and translation difficulties in motor tasks. According to the study, aging is a research frontier which has great promise for a deeper understanding of motor skills throughout the life span. So far, the motor learning literature of physical education is nearly devoid of such work, and it seems that research has totally neglected the latter half of the life span of humans. (JS)

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AGING AND MOTOR SKILL: A RESEARCH FRONTIER

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AGING AND MOTOR SKILL: A RESEARCH FRONTIER

Age and time are nearly synonymous terms for most people. The baby matures, reaches adolescence, moves into adulthood, acquires responsibilities, peaks in middle age, notices declines in function and finally combats the inability to adapt to environmental demands and either succeeds for awhile or ceases to exist. Aging is not a voluntary activity but a peculiar phenomenon of all living organisms, plant and animal, for which there is no remedy. To define aging is a difficult proposition mainly because the mere passage of time is not definitive since one must think in terms of complex phenomena which occur as a function of time but not necessarily caused by time. Consider the chronology of age as a definition of aging and you are faced with a wide range of individual differences in physiological response to physical stress, physical appearance (skin, hair, etc.), psychological styles and social competence even when time is held constant. Immobilization (bed rest studies) over periods of time can cause the physiological responses of the body to resemble aging. Certain diseases can cause premature aging where a twelve year old body resembles and functions as if it were eighty. In short, an explanation and definition for aging is elusive and an appreciation of the multi-variate nature of the collection of phenomena (biological, psychological and social) included in the term aging is a prerequisite to the conceptualization of aging. In The Coming of Age, Simone de Beauvior states

> "In fact, as far as our own species is concerned, old age is by no means easy to define. It is a biological phenomenon - the elderly man's organism displays certain peculiarities.

> It brings with it psychological consequences - certain forms of behavior are rightly looked upon as being characteristic of old age. And like all human situations it has an existential dimension - it changes the individual's relationship with time, and therefore, his relationship with the world and with his own history. Then again, man never lives in a state of nature; in his old age, as at every other period of his life, his status is imposed upon him by the society to which he belongs. What so complicates the whole problem is the close interdependence of all these points of view (14)."

We might broadly define aging as the declining ability of the individual to adapt to environmental demands especially during the last quarter of the life span where the probability of death is greatly increased. Barring accidents, disease and other unforseen circumstances of life, we shall accept natural aging and concern ourselves with the ages of fifty, through retirement and beyond. There is some debate as to what elderly or old age means but if we think of an age range, we can include late middle age and the centenarians as well. Birren (5) argues that aging needs to be defined as beginning when size, form and function have arrived at a steady state, otherwise it would be difficult to distinquish between growth and aging where both are characterized by irreversibility and accumulation. There is some serious question whether aging is random or programmed through genetics (biochromicity) for selective deterioration. Various models and explanations for aging have been suggested. There are one factor models which propose a "self destruct" idea as a result of disease and hypoactivity, circulatory failure, noxious chemicals or sinister hormones. Another idea is a simple "wear and tear" machine model which views acceleration of aging where body parts are most vulnerable due to overloading and stress.

The "second childhood" notion is a common phrase and implies reduction of mental capacity (senility) and the regression of the organism along the lines of early development. These theoretical notions about aging are typically ill developed because most of the work in the vast field of gerontology has been exlusively data collection oriented with a dearth of speculation which is so necessary for theoretical structures. Most of the available data appears in the Journal of Gerontology and is now being produced by an active research enterprise both by established scholars and graduate students. Some work in exercise physiology has been produced by physical education researchers. (notably H. de Vries) and a growing literature exists concerning the medical, biological, psychological, sociological and retirement parameters of the aged. Psychological aging can be viewed a number of ways:

1. We can consider behavior and life style in relation to longivity (studies of the super old in Russia, Afghanistan, Ecuador-Peru), physical activity, marriage, alcohol, active life, etc.
2. We can consider the relationships that have been found between behavior - personality and CV disease.
3. We can consider social roles and behavior in homogeneons vs. heterogeneous cultures (USA) and their effects on aging.
4. We can consider the individual and internalized feelings about personal aging - how do people experience aging and "model" it for themselves?
5. Last, we can consider man as an information system which, in the process of aging, may increase the storgae of information but search it more slowly. The old may process bigger chunks whereas the young may process more bits per unit time. In fact, the old may process too much information, both relevant and irrelevant.

In general, however, the sub area of motor skills has not received the attention it deserves even though it has been twenty-three years since Welford's Skill and Age (34).

It seems that Welford's work (34) has laid a foundation of observations and questions upon which succeeding work in motor skills and age has been based. The phenomena of "slowing" of performance is such an observation in old age. Does this slowness result from decreased stimulus strength, perceptual limitations (central and peripheral), impaired memory (especially short term), incautiousness and rigidity, speed of responses (time limits), increased reaction time (decision time) or inability to use feedback? Welford (33,34,35) suggested that central nervous system impairment was the main limitation and the presumed loss of capacity was reason enough for older persons to trade accuracy for speed of response. Complex tasks would easily cause more problems and, in fact, simple tasks can display little difference in speed and accuracy between young and old subjects. The ability to "pace" responses at a personal speed became another important variable in performance of the aged. A number of researchers have also pointed out the wide range of inter-individual variability among older performers but to date, intra-individual variability has yet to be studied. These initial speculations sparked a good deal of research that I have attempted to review. I will take some time to speak about some psychological correlates of motor skill in the aged before looking at the reviewed material because it is important to view the total individual.

Aging, for some persons, presents a great threat to the ego and can cause self hate and fatalism especially where a person attempts to defend himself against aging. Many older person simply withdraw or disengage themselves voluntarily from many activities and social settings which had defined a large part of their lives. Those who remain self directed and interested in the world nearly always survive longer than those who become apathetic and passive.

It is possible that introversion and cautiousness would increase and achievement needs and responsiveness would decrease. Conforming behavior and depression are often easily noticed in the elderly. Retirement, of course, is a major event in the lives of especially males and may signal lonliness, isolation and a profound change in social competence. Rigidity in old age has been studied by a number of researchers (9,12,8,24,23,11).

> "Old dogs and new tricks suggest not that advanced age is associated with lowered ability to learn but that advanced age is associated with a lowered ability to unlearn that which is already integrated into well-established thought and behavior systems. Old dogs are less likely to develop new solutions to problems and new ways to doing things (8)."

Resistance to change is noted here which grasps cognitive, personal and motor factors in an inflexible embrace. These findings indicate something about the strategies for learning motor skills that must be employed with older persons. It might be best to have flexibility as a goal rather than performance goals or quantity of learning. A need for certainty is apparent here also and the related low-risk probability of mistake avoidance.

These characteristics of old age and behavior, while not crucial to motor skills and performance, are certainly important in understanding the framework through which the elderly function in learning. An unending number of research topics can be cited in attempting to locate social psychological parameters which contribute to motor learning and performance difficulties. For example, it is known that as aging advances, many persons carefully alter their self concept and feelings about their body which is gradually declining in efficiency. This lowered body esteem can contribute to a decreased motivation to exert oneself physically, feelings of inadequacy and fear of failure.

Old dogs and old tricks would suffer as well as any new tricks.

Evidence for modification of sensation and perception in aging is clear and reliable (13,30). Vision has received much attention and it can be documented that there are decreases in visual acuity, ability to focus, a need for increased illumination and changes in adaptation to darkness. The visual sense, then, can contribute to a decline in motor skills due to inability to gather pertinent evaluative feedback to provide appropriate adjustments. However, data on the kinesthetic feedback processes is virtually nonexistant although there is some work on persistence of stimulus traces in the somesthetic nervous system (3,4). In these studies, older subjects were seen to persist in aftereffects (figural and spiral) much longer when compared to young subjects. The popular explanation is that since older persons are engaged longer in perceiving and responding, they will not be as responsive to new information and hence, will cling to the impression of old stimuli longer. This has direct implications for response amendment and refractoriness. More recently, Welford (33) has pointed out that in subjects 18 - 33, 300 m secs. was an average refractory period whereas for subjects 58 - 71, this period was 500 m secs. and indicates poorer temporal resolution. Other sensory modalities such as hearing commonly undergo marked change with age and taste, smell, pain and touch seem to change as well but not as dramatically. As in many other areas of motor skills research the question becomes one of location for the changes - peripheral or central?

Generally, the clearly documented decrease in peripheral nerve conduction speeds (5,8,9) has not convinced researchers that it is a factor to be carefully considered in perceptual speed. Speed of transmission is slowed in old subjects (51.4 m/sec verses 58.4 m/sec) but this decrease amounts to only 4% of the reported total decrease in time from 30 to 80 years.

There is some indication of changes in sensory organ reception thresholds at the periphery but the data is sparse and incomplete. In short, the point of view, on the reception side, is that the slowing must be found within the CNS. The summation of synaptic delay in the CNS is one speculation. Decreased blood flow to the brain has seem some attention as lowering electrical activity due to oxygen lack (some say that this is the basis for senility and must be treated by oxygen administration). Premotor time has been shown to increase (32) and since it comprises possibly 80% of reaction time and includes the central interpretation (decision) time, it indicates CNS slowing. Preparation of a response program by the older person becomes difficult and set maintenance, including attention is a contributing factor. Birren, and Botwinick, in a series of studies (6), attempted to correlate cognitive skills with reaction time in order to demonstrate the CNS location of slowing and produced correlations of r = .30 between paper - pencil tests and RT, r = .53 with digit symbols of the WAIS and r = .60 with hearing loss. Clusters of correlations need to be looked at and very probably, there is such a thing as specificity and generality of slowing especially since aging is selective. Reaction time studies have been frequent in the literature of gerontology and generally indicate slowing with age especially in discriminative and choice situations (7,18,21,31). The evidence does point to the CNS as the location for the slowing that Welford spoke of.

Surwillo (28,29) indicates that there are alpha rhythm changes with age as part of the EEG and he regards this as a factor in slowing. He reports a correlation of r = .81 with reaction time and alpha rhythm and that alpha rhythm serves as a cyclic biological clock. This amounts to a hypothesis that alpha rhythm changes are a key to the observed slowing because of their internal timing role.

Rabitt (22) points out that senescent humans and obsolete computers is more than a whimsical analogy. A computer may be slow simply because its component switchery is slow. It may reduce data rapidly or slowly depending upon the program. Finally, the computer speed may be a direct function of its size and capacity. He feels that the old have been inefficiently programmed - their behavior may be a precaution against failing capacities and time is spent verifying each stimulus with extreme caution. Difficulty in separating signal from noise implies a loss of storage for cues and analogs of input and this may indicate the necessity of sequential and not parallel stimulus interpretation. Some models of these complexities including the multi variate nature of aging might be illustrative and helpful at this point in the speculations. Comparisons of youthful age related change in these parameters with old age changes in "life span models" might be instructive. The notion of slowing simply needs a theory and models at this point before much more data is collected.

Memory has received quite a bit of attention from researchers in gerontology. A methodological problem is evident in most of the studies on memory which compare young and old subjects over retention periods of 24 hours to one week. Wimer and Wigdon (36) point out that the degree of original learning has not been controlled in most studies and may reflect the fact that an overlearned task is less subject to interference and old subjects may not have learned enough to retain. In paired associate research where original learning is controlled for, recall scores showed no difference between young and old ages over intervals up to one week (15,16). This contradicts popular notions about forgetfulness and aging and some of the research findings as well. Immediate or short turn memory losses appear to be more severe in the aged.

It has been pointed out in rat studies that consolidation may be slower in later life and when combined with rate of response where a subject does not have the opportunity to self pace, perceptual traces may indeed be impaired so that a comparator for correction purposes is never coherent. McGhie, et. al. (19) found that a decline in immediate memory with age is much more severe for visual material may exert an overload on an already limited storage capacity. One wonders here about the fate of kinesthetic information in such a system.

Some older persons do seem to be able to recall events that happened in their childhood and have a remarkable ability to detail a variety of experiences. This long term memory is not available to test very carefully and it must be clear that meaning and reinforcement variables play a major role in this type of memory. Studies are equivocal and scarce in this area. Schonfield and Robertson (27), working with lists of words, showed a greater loss of ability to retrieve (recall) rather than recognize (storage). Rates of search are involved heavily in recall and older persons do need longer time to retrieve information both in short and long term situations (1,2,20). Perhaps it is not retrival which is the problem but the relative difficulty of tasks. Confusion in memory could be created by conflicts in length of task (physical dimensions) and magnitude of responses required by the task. If there is a smaller capacity for storage, poor registration of information for future responses and inefficient search, then difficult task dimensions are likely to be confused due to their complexity.

Again, mainly with verbal material, research into learning has been instructive for those who wish to teach older persons. For the aged, it may be truer that learning may lack expression due to adaptation and correlated extraneous variables linked to performance.

Pacing or the speed of presenting stimuli is crucial to the older person - he must be able to self pace. Often, old persons will make errors of omission rather than comission in decisions simply not to respond. Longer periods between stimuli benefit the elderly both for inspection and anticipation (10). Performance on paced tasks depends upon the stimulus duration, signal to noise ratio (ease of distinguishing the stimulus), the interstimulus interval and the number of responses per unit time. Fast pacing or imposed pacing will cause poorer performance due to failures in STM and attention where the old person does not have time to perceive and classify stimuli. Response repression may be the result or many errors of comission. The arousal level of older persons will have something to do with performance fluctuations since motivational levels and interest decline. This may be true for all of us but for the aged, it is peculiarly difficult since the older person needs familiarity and meaning for responses in greater and greater amounts. Aids to learning, either artificial or natural, as mediating techniques, have proven helpful in some studies (17). Giving help with associations so that a person understands the interrelated nature of responses combats the impoverishment and even erasure of experience that may have happened over a life span.

Research possibilities in aging and motor skills are unlimited. Some research has been done to unravel the receptor and translation difficulties that old persons have in learning but this has been mainly verbal learning. Very little has been done using motor tasks except in the pioneering efforts of Welford and virtually everything that we have done with the ever present college age subject can be duplicated with aged subjects. The motor learning literature of physical education is nearly devoid of such work and it is as if we have totally neglected the latter half of the life span of humans.

Of course, old people are not a part of the schools of this country nor are western societies terribly interested in their old people. Kay has commented that

> "The volume or work in the area of motor skills by older subjects seems suprisingly thin, particularly in view of the pioneering studies that were done in the 1950's. There are many areas in skilled performance that would repay the further work of the gerontologist, such as the rate of learning in relation to final performance and the different sources from which older subjects may be taking information as they learn a skill. We should know how well an older subject can learn and perform a skill where feedback is augmented or reduced (18).

Most of the studies that have been done in gerontology have been cross sectional research where patterns of aging tend to get confounded with temporal events and the particular factors a person has been exposed to. Generational influences do cause some cross sectional data to be worthless. Longitudinal studies, on the other hand, are more definitive but are difficult to do and have deep cultural influences. Schaie (25,26) has developed a model for studying developmental changes which is attractive for studies in aging. To combat the confounding of culture, generation, maturation, age and time of measurement, Schaie suggests that a repeated and independent measures design be employed where ½ of n gets pretest at time X and the other ½ gets test at time Y. In addition, a time lag design can be used where several cohorts (members of a group) are examined at different times to control for age, cohort (culture) and time of measurement. In effect, one could carry out time lag, cross sectional and longitudinal studies simultaneously. There is a need for a life span view of psychological development since it occurs at all ages in accord with task and responsibility demands. Age specific developmental models miss the fullness and life patterning of of behavior.

Biological maturity is my thological since individuation and differentiation continues until death. The old will live longer and healthier, adapt multiple careers, comprise a larger and larger portion of the population (decreased birth rate) and command great bulks of leisure time in the future.

This is a research frontier which has great promise for a deeper understanding of motor skills along the life span. It deserves our attention and creativity. Many of you will be living into the Twenty-First century with the motor skills that you have now. What sort of new tricks will you be able to cope with and learn? How efficient will you be when aging is well underway in your body? My, how time flies.

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